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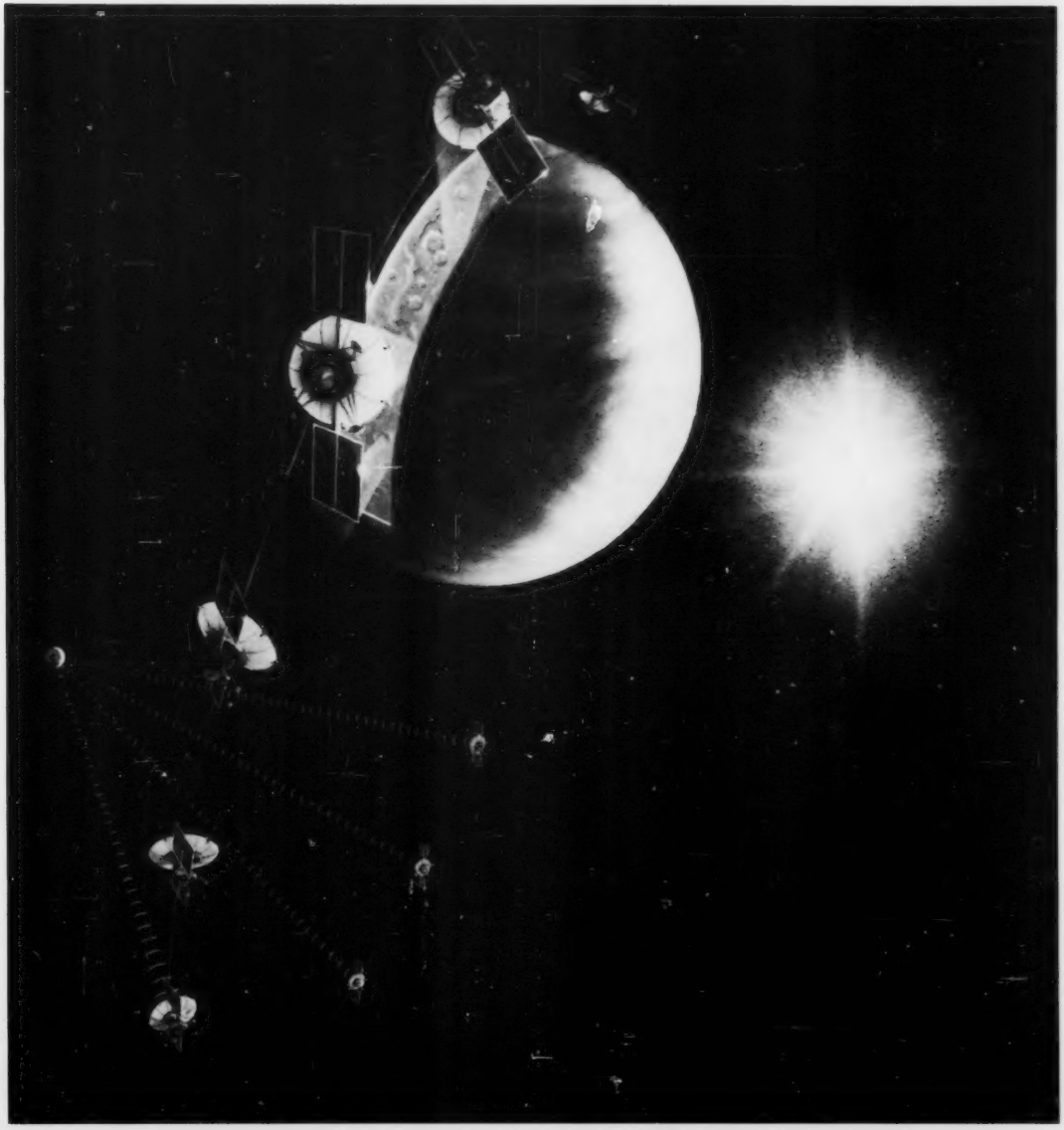
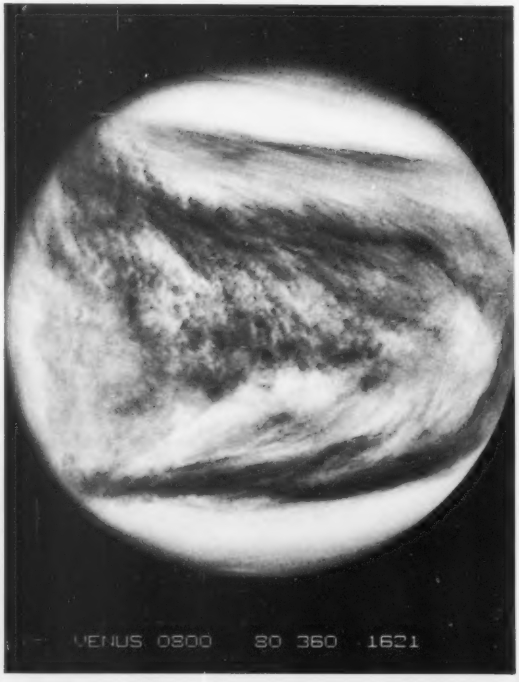


About the Cover

New Venus Mission?—Artist conception of proposed Venus Mapper operating in various stages of its elliptical orbit. The spacecraft would use imaging radar to penetrate Venus' global cloud cover (as shown at center). The imaging radar system, called Synthetic Aparture Radar would operate once each orbit for approximately 40 minutes from an altitude as low as 250 km (155 miles). This mapping effort would continue for 243 days and would result in detailed radar images of 90 percent of the planet's surface. Venus Mapper is proposed by NASA's Jet Propulsion Laboratory, Pasadena, Calif., as a new mission for the agency's Office of Space Science and Terrestrial Applications.

Below is Pioneer photo of Venus taken within the last two years revealing the planet's heavy cloud cover. Venus' clouds rotate around the planet every four days. Pioneer Venus will remain in orbit until 1986.



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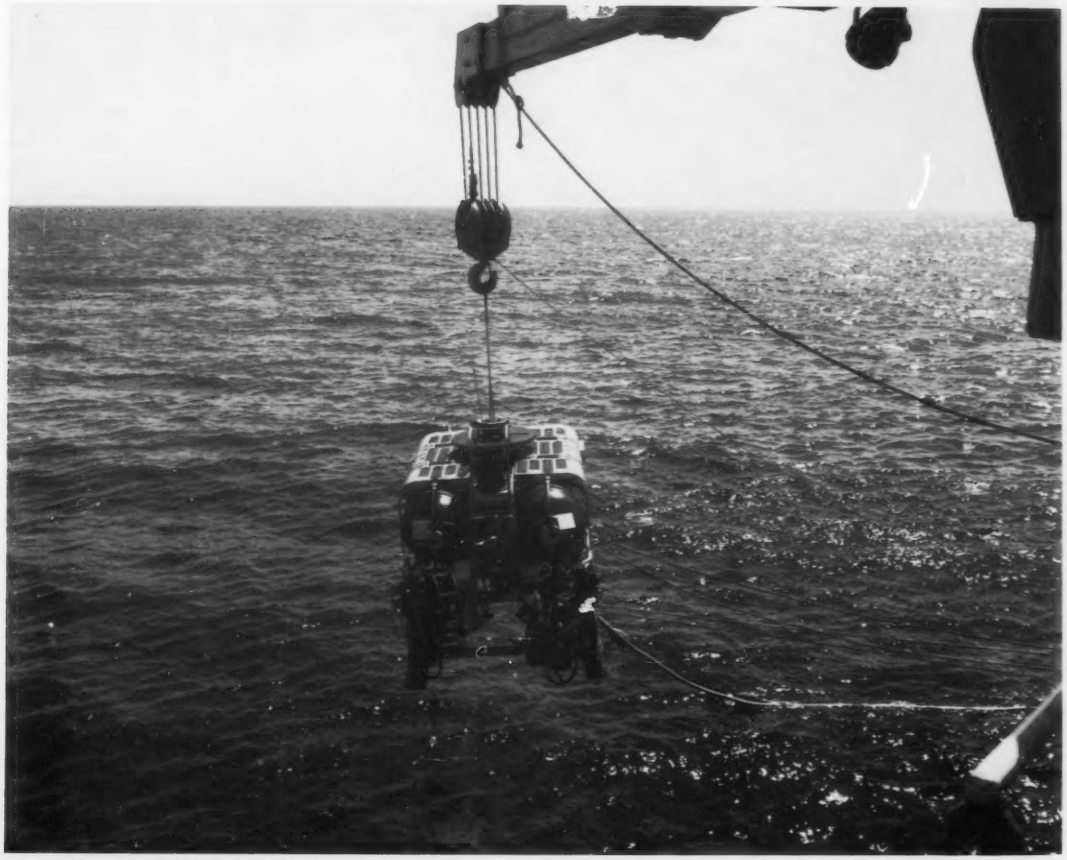
Robot Underwater Investigator Aids NASA

Roughly two minutes after the fourth launch of Space Shuttle Columbia on June 27, the twin solid rocket boosters separated as scheduled from the orbiter and external tank and began their descent toward impact with the Atlantic Ocean, approximately 122 nautical miles (144 statute miles) downrange from the launch site. On this flight, however, a systems failure occurred that caused this hardware to sink to the depths of the ocean floor.

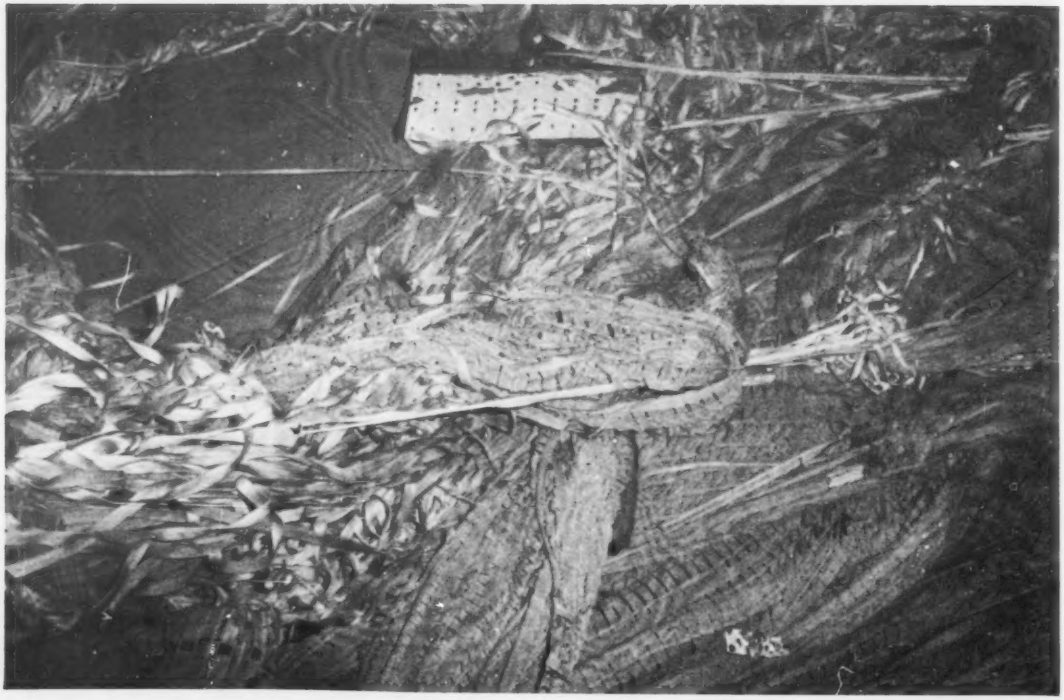
Radar located the boosters at a depth of approximately 3,500 feet—water too deep for humans in hard shell diving suits to inspect. For help in investigating the cause of the flotation failure, NASA turned to a unique "ocean robot" called SCARAB. Engineered and built by Ocean Search, Inc., Lanham, Md., this tethered unmanned vehicle works at any ocean depth up to 6,000 feet, limited only by the ability of the surface ship to maintain station.

SCARAB has power to operate in surface currents up to 3 knots and in underwater currents of up to ½ knot at 6,000 feet. It can function independently of other ship facilities as it is equipped with power generation and semi-automatic handling equipment.

SCARAB comes equipped with two heavy-duty hydraulic manipulators (or robotic arm and hand),



SCARAB, unmanned tethered robotic underwater ocean vehicle used by NASA to extensively photograph the solid rocket boosters lost during the fourth Space Shuttle flight. This ocean robot performs various tasks in ocean depths up to 6,000 feet; the boosters sank in ocean water about 3,500 feet deep. The vehicle is shown being launched from one of the booster recovery ships.



complete optical system, six 5 hp electric thrusters, high resolution sonar, navigation system, and four magnetometers.

Of particlar interest to NASA was SCARAB's camera system. Three television cameras mounted on separate pan/tilt mechanisms allow real-time observation and video tape documentation; one 35-mm still camera also is mounted on a pan/tilt system. Six quartz-iodide flood lights provide illumination in the darkness of the ocean depths.

Tethered from one of the solid rocket booster recovery ships, UTC Freedom or Liberty, SCARAB's initial assignment was to photograph extensively the damaged boosters. Navigational control for SCARAB was handled by a remote station set up on the recovery ship. The operator hut and bridge displays provided complete vehicle status information such as range/bearing, heading, depth and pitch/roll of the vehicle.

SCARAB's documentation was shipped back to NASA's Marshall Space Flight Center, Huntsville, Ala., for analysis by an investigative board set up to determine the cause of the booster deceleration failure. The photographs revealed that the boosters were broken up by the force of the water impact. One was broken into a large number of parts; the other booster has the forward skirt and top solid rocket booster segment intact, a section about 12 meters (40 feet) in length. This section of the booster contains the flight recorder and other electronic equipment that could provide useful information to the investigative board on the cause of the failure.

NASA has decided to raise this part of the booster assembly for inspection. Procedures are being developed to perform the recovery operation. The largest piece of booster debris has no built-in lift points and probably has a large amount of sea water trapped inside.

However once recovery procedures are established, SCARAB will be used for an integral phase of this task. Using its robotic arms, the underwater robot can cut large diameter wire rope and attach large capacity recovery lines to the sunken booster. The vehicle's manipulators are manufactured with adaptable mounting surfaces which allow for custom selection and fitting of tools for a wide variety of ocean work applications. The solid rocket booster recovery ships or salvage ships will perform the hydraulic lifting operation required to raise the hardware from the ocean floor.

Several of SCARAB's photographs of the fourth Shuttle missi on sunken solid rocket boosters taken from an ocean depth of about 3,500 feet. At top, a nearly complete solid rocket mo tor casing and assorted debris are visible. The tubing in the foreground of the photo is on SCARAB. In bottom photo, booster parachutes and parachute lines form a tangled web pattern on the bottom of the ocean floor.

U.S. Participates in International Space Conference

In August NASA Administrator James M. Beggs headed the U.S. delegation to Unispace '82, an international conference created to promote greater global awareness of the state of space technology and its potential benefits to mankind.

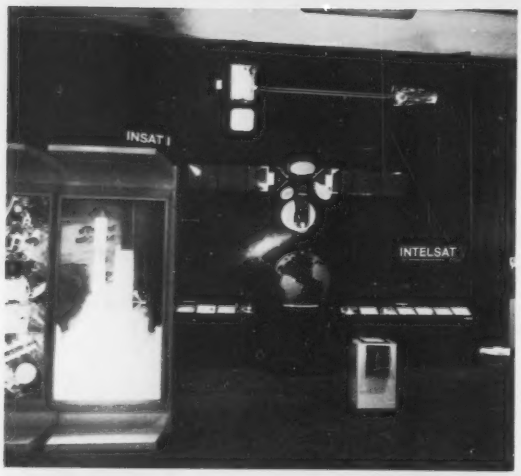
Held in Vienna, Austria from August 9-21, the conference focused on international cooperative activity in space, with particular emphasis on how space technology can help promote economic development in the world's poorer countries.

The agenda for Unispace '82 was divided into three broad categories: (1) state of space science and technology; (2) applications of space science and technology; and (3) international cooperation and the role of the United Nations. Within these categories, detailed discussions were held on such global concerns as economic development, education, communications, resource management, environmental protection and the utilization of space technology with respect to these areas.

Unispace '82 (or the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space), drew participants from over 140 countries and international organizations. The first conference of this kind held in 1968 had 78 participants.

The U.S. delegation entered Unispace '82 with a substantial record of international cooperative space effort. Since its inception in 1958, NASA has signed over 1,000 agreements with over 100 countries for cooperative space programs. The agency has worked

NASA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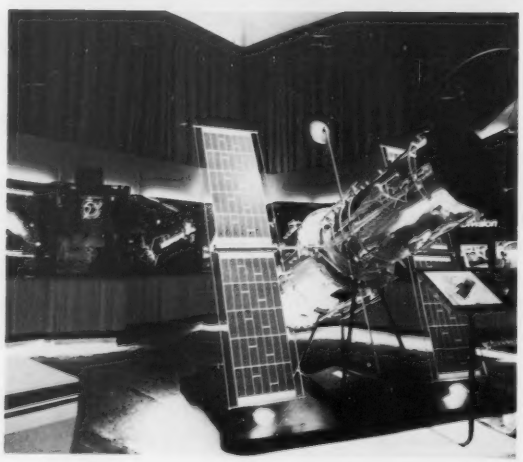
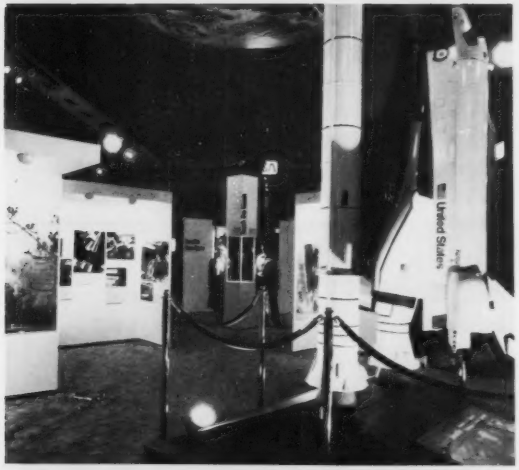
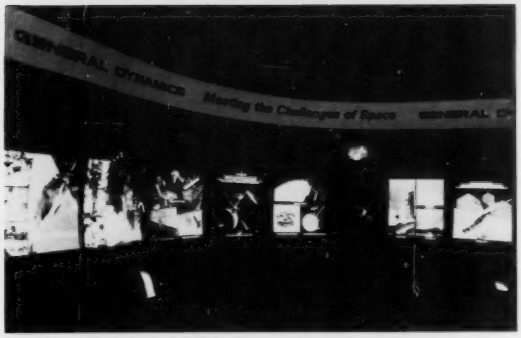


MARTIN MARIETTA





Opposite page and above: Scenes from the U.S. exhibit at Unispace '82, an international conference created to promote greater global awareness of the state of space technology and its potential benefits to mankind, Vienna, Austria, Aug. 9-21.

with the European Space Agency (ESA) on many projects, the largest being Spacelab; and with Canada, France, Germany, Italy, the Netherlands, Spain and the United Kingdom on cooperative spacecraft projects.

In the context of the Landsat project, NASA has helped developing countries apply remote sensing technology for crop prediction, mineral and ground water exploration and resource management and mapping. In addition, the Agency for International Development has established a Rural Satellite Program using small stations and existing satellite systems to provide basic communications services, health care information, agricultural advice and radio and television learning programs to impoverished areas of the world.

One example of the application of space technology to development, was India's SITE (Satellite Instructional Television Experiment) program, August 1975-1976. Using the NASA AT-6 satellite and conventional television sets augumented with special electronics and antennas of chicken wire, the program brought education, farming and health information to a largely illiterate population in 2,400 rural villages. Viewers learned better agricultural methods and hygiene in their many dialects. The programs were beamed from India through the NASA-provided ATS-6 satellite that hovered over Kenya during the year-long experiment.

Similar satellite signals originating from a U.S. ground station had previously been educating children in Appalachia and communicating medical diagnoses in Alaska.

More than 20 countries displayed exhibits at Unispace '82 including the United States, Japan, West Germany, France, Canada, India, and the Soviet Union. The theme of the U.S. exhibit was "Working Together to Benefit Spaceship Earth." It consisted of 12 total exhibit structures; one from NASA at the center surrounded by 11 others from U.S. companies, visually linked to demonstrate U.S. leadership in space as the result of both government and private sector contributions.

The 11 companies participating in the U.S. Unispace exhibit were: Ford Aerospace, General Dynamics, Grumman Aerospace, IBM, International Imaging, Lockheed, Martin Marietta, McDonnell Douglas, RCA, Rockwell International, and Townsend Associates.

Over 10,000 people viewed the U.S. exhibit each day.

In addition to providing extensive exhibit materials, the United States participated in several live demonstrations of space technology at the Unispace conference. The Communications Satellite Corporation (COMSAT) provided remote interpretation services for part of the conference proceedings via satellite telecommunications link between Vienna and the United Nations Headquarters in New York City. The National Oceanic and Atmospheric Administration (NOAA) contributed hardware for use in demonstrating meteorological satellites coordinated by the World Meteorological Organization. NASA sponsored two demonstrations: one of low-cost equipment for processing remote sensing data; the other of photovoltaic technology which is being utilized to provide electricity in developing countries.

The first international United Nations space conference was held in Vienna in August 1968 and, like Unispace '82, originated with the United Nations Committee on the Peaceful Uses of Outer Space. The U.S. delegation to the conference, upon which the current Unispace delegation is modeled, was also headed by a NASA Administrator: James Webb.

Since the first world space conference, enormous achievements in space science and technology have taken place:

- landing of men and robot vehicles on the Moon;
- automated landers on Mars and Venus;
- missions past Jupiter and Saturn;
- manned Skylab missions;
- Space Shuttle—world's first reusable spacecraft now a fully operational Space Transportation System;
- routine operation of space communications satellite systems which provide international meteorological, navigational and maritime communications as well as remote sensing data.

Since the first world space conference in 1968, more and more countries now enjoy the benefits of the practical applications of space technology:

- Indonesia connects its thousands of islands together through a national communications satellite system;
- India is building its own satellites and launch vehicles and is establishing a multipurpose communications and meteorological satellite system;
- Five developing countries—Argentina, Brazil, India, Indonesia and Thailand—have established Landsat data acquisition and processing facilities.

And international participation in space-activity related organizations has dramatically increased:

- membership of the United Nations Outer Space Committee has grown from 28 members in 1968 to 51 today;
- INTELSAT from 68 members in 1968 to 105 today;
- International Maritime Satellite Organization, established Feb. 1982, already has over 30 members;
- European Space Agency (ESA), grew to its present form of 11 member nations: Germany, Belgium, Denmark, Spain, France, United Kingdom, Italy, Ireland, the Netherlands, Sweden and Switzerland. Norway, Canada and Austria are observers.

The heavy international interest and participation in Unispace '82, almost doubled from the first conference 14 years ago, illustrates that the nations of the world are realizing that space technology can help to improve the quality of life here on Earth. One of the purposes of Unispace is to further this goal.

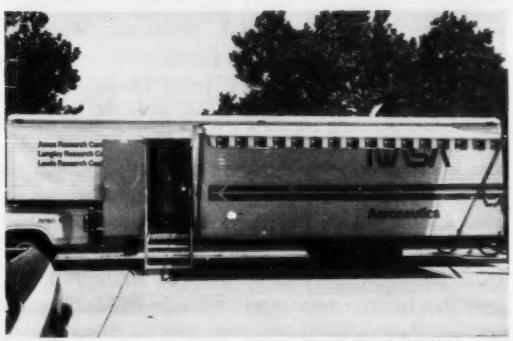
Oshkosh: Salute to NASA Aeronautics

"Salute to NASA Aeronautics" was the theme of the 1982 Experimental Aircraft Association National Convention held in Oshkosh, Wisconsin, July 31 to Aug. 7. Highlighted at the world's largest annual aviation convention was NASA's research and advanced technology developments in civil, military and general aviation.

NASA provided one of the convention's largest exhibits housed in a tent structure called the NASA Central Pavilion. Under the canvas were high technology displays and audio visual presentations focusing on agency research and development programs such as vertical and short take-off and landing aircraft (V/STOL), aircraft safety, advanced turbo-prop installation and HiMAT (Highly Maneuverable Aircraft Technology).

An estimated 600,000 people visited the NASA Pavilion during the convention's eight days.

Also present was NASA's newest traveling exhibit unit, AEROVAN, a walk-through trailer housing nine non-technical exhibits which focus on current



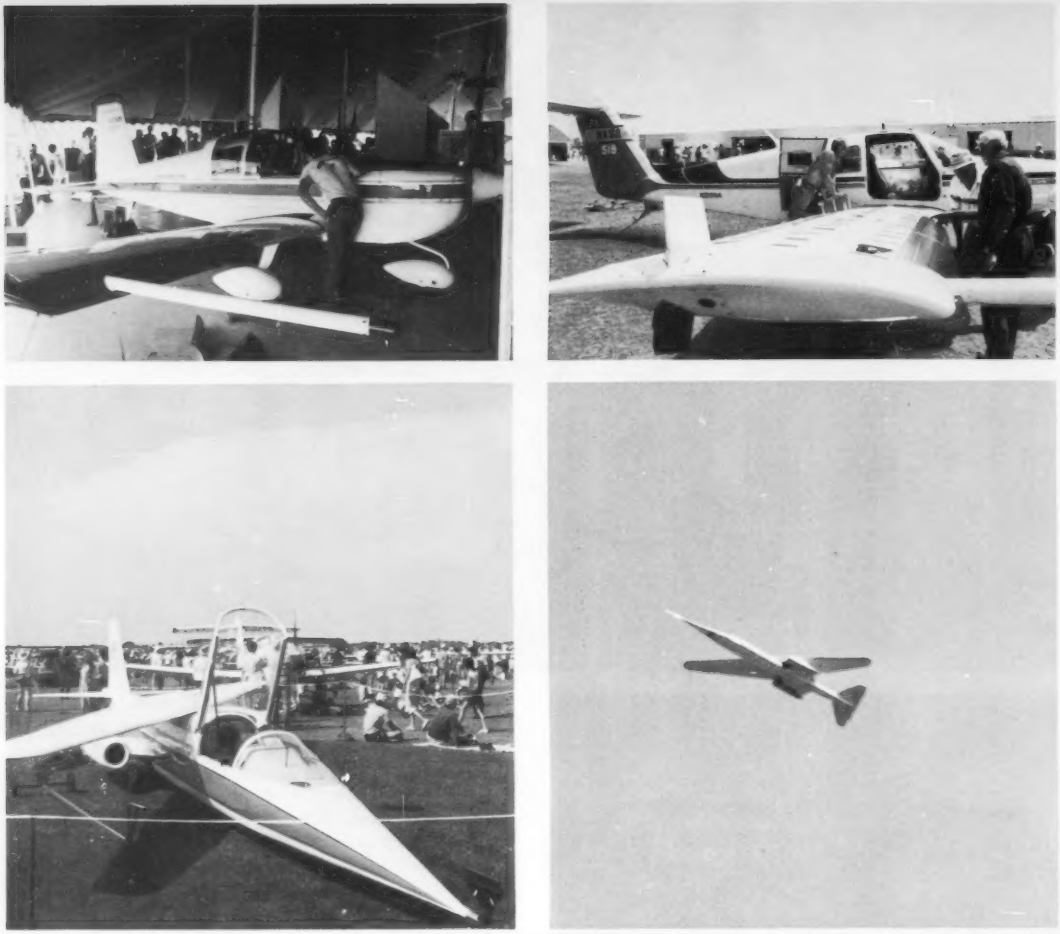
Scenes from the 1982 Experimental Aircraft Association National Convention held in Oshkosh, Wisconsin, July 31-Aug. 7. Theme of the convention was a "Salute to NASA Aeronautics." Top frame is of NASA's main exhibit area called the NASA Central Pavilion. At center left, NASA Administrator James M. Beggs studies one of the pavilion's many exhibit panels and displays. At bottom left, NASA's newest traveling exhibit, AEROVAN, on hand at Oshkosh. The trailer houses nine non-technical exhibits on current aeronautic research.

aeronautical research in safety, energy efficiency, environmental compatability, and improvements in passenger comfort and convenience.

One of the NASA aircraft on display was the AD-1 oblique-wing aircraft, sometimes called the scissors wing. This aircraft flies at low speeds with its wings in the conventional position; at high speeds the wings pivot to an oblique angle of up to 60 degrees which reduces drag and increases speed and range without an increase in fuel consumption.

Other aircraft on display at the Oshkosh convention were two of NASA's general aviation spin research aircraft (NASA 501 and NASA 519).

NASA Administrator James M. Beggs, and



Photos at top are of two of NASA's general aviation spin research aircraft sent to the convention from NASA's Langley Research Center, Hampton, Va. Bottom frames show the the NASA AD-1 oblique-wing aircraft also on hand at Oshkosh. At bottom right, this aircraft gives a flight demonstration of its unusual wing pivot feature.

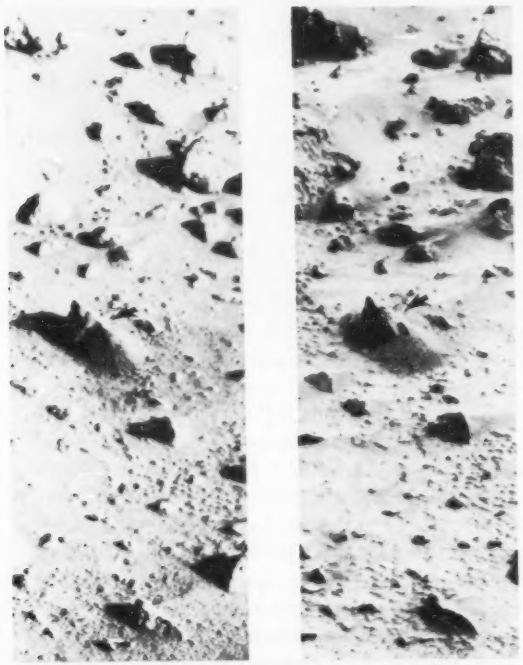
Associate Administrator for Aeronautics and Space Technology, Dr. Jack L. Kerrebrock, participated in convention activities along with NASA aeronautics center directors Dr. Donald P. Hearth of Langley Research Center, Hampton, Va.; Andrew J. Stofan of Lewis Research Center, Cleveland; and C.A. Syvertson of Ames Research Center, Mountain View, Calif.

Ten scientists from NASA's three major aeronautics centers were honored for distinguished aeronautical research at the convention. From Ames, honorees were: Seth B. Anderson, Robert D. Reed, Murray Tobak, and R. T. Jones; from Lewis, Abe Silverstein, John S. Evvard, and J. Irving Pinkel; and from Langley, Richard T. Whitcomb, W. Hewitt Phillips, and John P. Reeder.

Researchers from NASA's Ames, Lewis and Langley centers presented a series of technical papers at convention forums. A NASA information tent was staffed by public information personnel to assist convention attendees and participants with materials on NASA programs. Various publications and visual materials were available for distribution. In addition, three NASA aerospace lecturers provided lecture demonstrations using slides, models and other visual aids.

For the eight days of the convention, Wittman field at Oshkosh became the world's busiest airport, nearly four times busier than Chicago's O'Hare Field by comparison. Over 10,000 aircraft swelled the usually quiet Oshkosh airport for this event.

The convention used 877,187 square feet of indoor and outdoor exhibition space; 350 representatives from aircraft manufacturers, retail and wholesale parts and aviation services attended; and over 200 educational forums and workshops were produced by the Experimental Aircraft Association during the convention.



Images from Mars—Two photos of the Martian surface taken by the Thomas A. Mutch Memorial Station (Viking Lander 1) in the Chryse Basin in the northern hemisphere of Mars show a 5-cm (2-in) pile of soil placed beside and partly atop an 11-cm (4-in) rock by the lander's soil-sampling arm in July 1977. The left photo was taken Feb. 1979; the right photo in July 1981. Comparison shows that some of the soil has been removed by the Martian wind to re-expose the rock, illustrating that as on Earth, deposition and removal of fine material is a continuing cycle on Mars. This pile formation, called Conical Pile # 4, is one of five placed around the lander to measure the amount of material stripped away with time. NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Viking project.

NASA-Sponsored Development Opportunities

NASA supplements employee development efforts by sponsoring a number of internal and external fellowship, work experience, and training programs for selected employees whose performance has demonstrated management ability. The annual cycle for selection is under way. Your local training office has program information, nomination procedures, and local suspense dates. The table below lists those programs which are available:

Title	Length	Nomination due in Hq
Fellowships		
Legis Fellows	6 mos.	10-1-82
MIT-Sloan	1 yr.	10-1-82
MIT Advanced Study	13 wks.	10-1-82
Stanford-Sloan	9 mos.	10-1-82
Education for Public Management	2 semesters	10-1-82
Hugh L. Dryden Memorial	10 mos.	10-1-82
Carnegie-Mellon Public Education	3 wks.	10-1-82
Harvard Senior Managers	3 wks.	10-1-82
Harvard Advanced Management	13 wks.	10-1-82
Harvard Program for Senior Executives	13 wks.	10-1-82
Harvard Program for Management Development	14 wks.	10-1-82
Syracuse Maxwell Midcareer	15 wks.	10-1-82
Simmons Middle Management	10 wks.	10-1-82
Congressional	10 mos.	10-1-82
Industrial College of the Armed Forces	11 mos.	10-1-82
Work Experience Programs		
Executive Development Work Experience	optional	2-15-83
SES Candidate Development	12-18 mos.	2-15-83
Career Development Program	1 yr.	2-15-83
Critical Assignment Development Program	optional	2-15-83
President's Executive Exchange	1 yr.	2-15-83
Management Education Center Wallops Island, Va.		
Executive Seminars	9 days	2-15-83
Management Education Program (MEP)	2 wks.	2-15-83
MEP Follow-On Seminars	1 wk.	2-15-83
Project Management Shared Experience	5 days	2-15-83

Fourth Shuttle Mission Experiment Data Analyzed

Investigators at NASA's Marshall Space Flight Center, Huntsville, Ala., are examining preliminary data for several experiments flown aboard the fourth flight of Space Shuttle Columbia in June: the continuous flow electrophoresis system experiment, induced environment contamination monitor, and monodisperse latex reactor.

The continuous flow electrophoresis system experiment, the nation's first commercial payload to fly aboard the Shuttle, "performed almost flawlessly" during the last mission according to Richard Brown, commercial applications manager in Marshall's Materials Processing in Space projects office. The system, designed and funded by the McDonnell Douglas Astronautics Corp., to separate biological materials according to their surface electrical charge, successfully separated six protein samples. The samples included a mixture of egg albumen and rat albumen to demonstrate the device's separation capability at an increased output in space, and a cell culture fluid which contained many types of proteins to test the capability to separate a large number of natural substances at the same time.

The experiment was flown on the Shuttle under terms of the first joint endeavor agreement through which NASA and industry share in the cost, risk and benefits of the endeavor. The agreement is managed by Marshall.

The samples separated during the fourth mission traveled through the electrophoresis column as expected, reported McDonnell Douglas spokesman Ray Deffrey. The electrophoresis experiment is scheduled to fly again on the sixth Shuttle flight in January 1983.

On Earth, gravitational effects limit the concentration of biological materials in the sample being processed to one-quarter of one percent and limits the sample stream size to one-half millimeter in diameter. During the mission, a sample of 25 percent concentration appears to have been processed in the experiment using a sample stream size of one millimeter. "The experiment demonstrated that the increased concentration, coupled with the increased sample stream size, could give 400 times more output than an Earth-based electrophoresis," said Walter Wood, Marshall manager of the joint endeavor agreement. "The objective was to achieve this output without degradation in purity," Wood said. Laboratory analysis of the separated samples is underway at McDonnell Douglas in St. Louis, Mo.

Marshall's induced environment contamination monitor flown for the third time aboard Space Shuttle Columbia, performed to specifications except for an anomaly during the plume pressure test. The monitor's operation was successful in completing a mapping of contaminants in and around the orbiter cargo bay when it was lifted up by Canada's remote manipulator system and placed at 25 locations. The monitor also completed another test which measured the interaction of a known gas released by the monitor with atmospheric gases at orbital velocity.

During a second exercise on the manipulator arm, the monitor was positioned over the nose of the orbiter to gauge the pressure wave generated by the firing of the reaction control jets, using a newly installed plume pressure gauge on the monitor. Due to unknown causes, the signal to activate the gauge apparently was not received by the monitor, according to Edgar Miller, project scientist in Marshall's Space Sciences Laboratory. The cause of this failure is under investigation. The induced environment contamination monitor is next scheduled to be flown aboard the Spacelab 1 mission in October 1983. The plume pressure gauge is not scheduled to be included as part of the monitor's instrumentation on this flight.

The monodisperse latex reactor experiment, which was developed by NASA's Marshall Space Flight Center and Lehigh University, Bethlehem, Pa., was the second step in the development of large monodisperse (identical size) particles which could have medical and industrial applications. The experiment was first flown on the third Shuttle flight in March. On the fourth Shuttle mission, four batches of latex "seed" particles were expected to grow in a range of sizes up to 10 microns. An early post-flight report stated "a malfunction of unknown origin occurred during the mission preventing the chemical process from taking place as planned."

However Marshall scientists have discovered that sufficient heating did occur in the experiment reactors, when coupled with the flight's seven-day duration in the zero-gravity environment of space, to allow the chemical process to be at least 55 percent completed. During the mission, the chemical reaction passed the critical stage which must be done

Agricultural Benefits—NASA research aircraft in flight over Virginia's Eastern Shore during performance testing on wing tip modifications designed to improve efficiency in application of agricultural sprays. Winglets, or vertical wings at the tip of a main wing, are used in this modified Ayres Thrush 800 to better control the movement of air that swirls off the end of the wings. Moderation of this movement can improve the spray pattern and reduce drift of agricultural materials out of the target area. The program is managed by NASA's Langley Research Center, Hampton, Va.

in weightlessness in order for the particles to be formed properly. Scientists at Lehigh University were able to finish the latex-forming chemical process on the ground. Principal investigator Dr. John W. Vanderhoof estimated the final particle size to have reached 7.9, 9.4, 10.3, and 10.8 microns, about 1½ to 2 times their original size. The monodisperse latex reactor is scheduled to fly aboard the next Shuttle mission in November.

Landsat 4 Returns First Images

Landsat 4 (formerly Landsat D), successfully launched July 16 from Vandenberg Air Force Base, Calif., is presently in excellent condition in its 694-kilometer (481-mile) orbit. Two of the spacecraft's highly sophisticated sensors—the multispectral scanner and thematic mapper—were activated and the first images taken by these instruments have been processed through the ground data system at NASA's Goddard Space Flight Center, Greenbelt, Md.

The multispectral scanner, flown on Landsats 1, 2, and 3, is a radiometer—an instrument that collects and measures solar energy reflected or emitted in discrete intervals of the green, red, and near infrared parts of the electromagnetic spectrum.

The multispectral scanner is used to delineate the extent and condition of a wide variety of vege-

First image from Landsat-4's thematic mapper taken July 20. The resultant 185 × 185 km (115 × 115 mile) image is a composite of three individual images from detectors in the green, red, and infrared portions of the spectrum. In this quadrant section enlargement of the image, nearly all of Detroit, Michigan, and the northern parts of Toledo, Ohio, are visible in the top and bottom portions of the picture, respectively. The large body of water in the lower right is Lake Erie and in the upper right is Lake St. Clair. In the lower (southern) outskirts of Detroit, near the center of the picture, the Detroit Metropolitan Wayne County Airport is visible and to its immediate left (west) is the Willow Run Airport. Landsat-4's thematic mapper was designed to be able to identify areas as small as 30 meters; preliminary examinations point to an image resolution and quality beyond expectations.

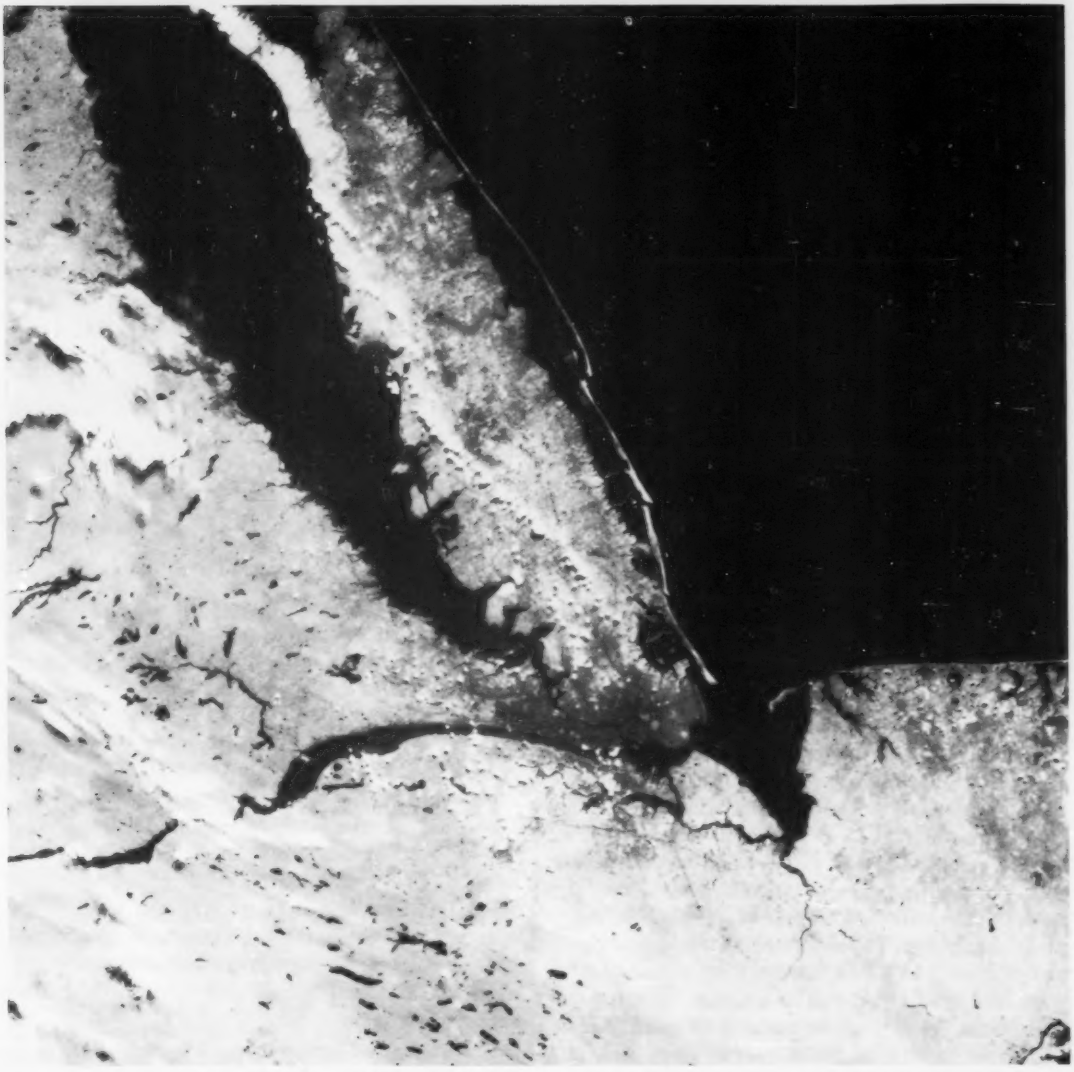
tation types, bare soil and rock conditions, and snow cover and water bodies over large areas on a highly repetitive basis. Data from the scanner has been used extensively over the past decade for agriculture, forestry range, water and land cover applications; for determining biophysical characteristics useful in crop yield modeling and for searching for new deposits of oil and mineral resources.

Landsat 4's multispectral scanner was activated on July 19 over New York City; the instrument has an approximate spatial resolution of 1 acre (80 × 80 meters).

The spacecraft's thematic mapper is a new instrument expected to advance the remote sensing

capabilities of Earth resources satellites. Thematic mapper provides data in seven spectral (light) bands with improved spectral, spatial, and radiometric resolution. The advantages offered by thematic mapper are in its multispectral observations. The mapper uses significantly narrower bands in the green, red and near infrared compared to the multispectral scanner which allow for increased reflectance and more precise measurement of vegetation on the green and near infrared bands; better distinction of chlorophyll absorption in the red band; and less chance of atmospheric water vapor obscuring land surface imaging in the near infrared.

With the thematic mapper's new band measuring reflected sunlight in the blue-green portion of the spectrum, natural color images of the Earth's surface



First multispectral scanner image from NASA's Landsat 4 spacecraft. Activated July 19 over New York City, the resultant 185 × 185 km (115 × 115 mile) image is a false color composite of three individual images from detectors in the green, red and infrared portions of the spectrum. The Verrazano Narrows Bridge is clearly visible across the New York Bay because of its high contrast with the water.

features are now possible for the first time on a Landsat spacecraft.

Thematic mapper was activated July 20 and its first image taken was of the Detroit, Michigan area. The spatial resolution of thematic mapper will be approximately ½ that of the multispectral scanner, or about 30 × 30 m (98 × 98 ft.). This allows for much smaller features on the surface to be identified and measured.

Data from Landsat 4's multispectral scanner and thematic mapper are presently being returned to ground stations using the direct access X-band and S-band communications systems. The spacecraft has a Ku-band data transmission system which will be used for data transmission when the Tracking and Data Relay Satellite is put into service early next year.

The Landsat 4 program is managed for NASA's Office of Space Science and Applications by the Goddard Space Flight Center, Greenbelt, Md.

Contractor News

NASA has selected eight companies for final negotiations leading to firm fixed-price contracts of less than $1 million apiece for space station mission studies. The studies will contribute to the development of specific mission requirements and overall architectural options for a Shuttle-tended, permanent orbiting facility that could be launched by 1990. The eight companies selected are: **Boeing Aerospace Co.,** Seattle; **General Dynamics, Convair Div.,** San Diego; **Grumman Aerospace Corp.,** Bethpage, N.Y.; **Lockheed Missiles and Space Co., Inc.,** Sunnyvale, Calif.; **Martin Marietta Aerospace, Denver Aerospace,** Denver; **McDonnell Douglas Astronautics Co.,** Huntington Beach, Calif.; **Rockwell International, Space Operations/Integration and Satellite Systems Div.,** Downey, Calif.; and **TRW, Inc., Defense and Space Systems Group,** Redondo Beach, Calif. These studies are part of a space station planning activity underway at NASA to develop a space station program for consideration by the Administration and Congress as the next major initiative in space. The studies conducted under these contracts will be eight months in length and are expected to identify and analyze the scientific, commercial, national security and space operational missions that could be most efficiently conducted by a space station. From this analysis, the contractors will develop alternative concepts for a station.

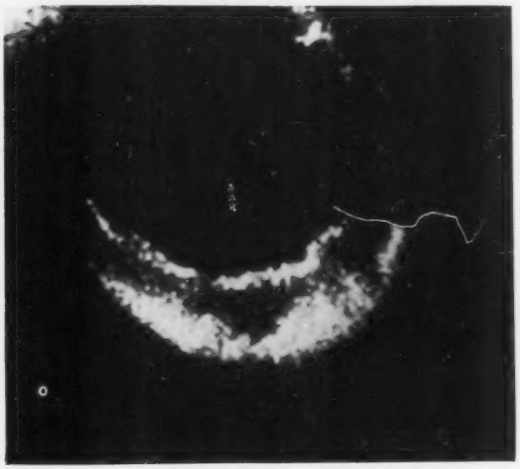
NASA Administrator James Beggs has announced that NASA will employ a **Space Shuttle processing contractor** at Kennedy Space Center, Fla., to handle preparations, launch, landing and turnaround activities for the Space Shuttle. The contract should result in significant cost savings during the Shuttle operational era. It will minimize interfaces at the launch and landing site and focus clear responsibility on a single contractor to improve flight safety and mission effectiveness. The change to a single Shuttle processing contractor will consolidate not only the contracts for flight hardware processing at Kennedy, but will also include the operation of ground support equipment and related support to fulfill Space Shuttle processing responsibilities. NASA expects to release a formal request for proposals by late November of this year with a contract award targeted for 1983.

Lockheed Engineering and Management Services Co., Inc., Houston, has been selected by NASA's National Space Technology Laboratories, NSTL Station, Miss., for negotiation leading to award of a new contract to provide technical services for its Earth Resources Laboratory. The initial award will approximate $6,456,000 for a two-year period and began Aug. 1, 1982. The contract contains options for an additional three years. NSTL's Earth Resources Laboratory develops applications of remote sensing data taken by Landsat's multispectral scanner and thematic mapper instruments. Laboratory investigators develop techniques for space applied data and other types of data to provide a comprehensive descriptive analysis of change on the Earth's surface in soil type, topographic relief, rainfall and population distribution. Data from the laboratory has been used in determining crop production, erosion factors, and reforestry needs because of erosion. Under terms of the contract, Lockheed will operate and maintain remote sensors in the Earth Resources Laboratory aircraft used for parametric studies where data is collected at ground truth level; operate and maintain the Lab's computer system and develop software to support research and development activities; and operate and maintain the Lab's special purpose photo lab.

Westinghouse Electric Corp., Advanced Energy Systems Div., Large, Pa., has been awarded a contract to develop technology for multimegawatt fuel-cell power plants. The contract, estimated at $37 million to be funded in increments over a four-

year period, was awarded under the Department of Energy's Phosphoric Acid Fuel Cell Systems Program managed by NASA's Lewis Research Center, Cleveland. The first phase of the contract, covering a 12-month period, will cost $5.4 million and will define the requirements for a fuel cell power plant. Subscale tests of cells and cell stack assemblies also will be initiated. The industrial goal is to have two 7.5 megawatt fuel cell power plants installed at sites before the end of this decade. **Energy Research Corp.,** Danbury, Conn., is the major subcontractor, a pioneer company in gas-cooled fuel cell technology.

Computer Sciences Corp., Falls Church, Va., has been selected by NASA's Kennedy Space Center, Fla., for final negotiations leading to award of a $9,372,000 firm, fixed-price contract for a Space Shuttle Inventory Management Systems (SIMS) II. SIMS II will assist NASA in ensuring that spare parts, supplies and materials are available as needed to support the Shuttle program. The contract will call for delivery of automatic data processing equipment; communications equipment; computer software; data requirements; training for terminal users, computer operators and system controllers; and software creation and maintenance personnel.



Captured Northern Lights—Usually "northern lights" or auroras can only be seen as a local glimmer in the night sky. Two NASA satellites, called Dynamics Explorers, are returning pictures of auoras as they investigate relationships between the Sun and the Earth. Photographed high over the North pole, the lights can be seen in true size perspective, circling the pole and brightening North America as far south as the Great Lakes. Working in tandem, the two satellites are measuring bursts of solar energy and observing effects on our planet. These bursts are of interest because they can severely disrupt radio communications and power lines, as well as influence climate and weather in as yet little understood ways. The Dynamics Explorer project is managed by NASA's Goddard Space Flight Center, Greenbelt, Md.

Pan American World Airways, Inc., Aerospace Services Div., Cocoa Beach, Fla., has been awarded a follow-on contract by NASA's Johnson Space Center, Houston, to provide plant maintenance and operations at the center. The $12 million cost-plus-award-fee contract runs from Aug. 1, 1982 to July 31, 1983 and covers operation of all Johnson's utility systems and maintenance of utilities, buildings, roads and special equipment at the center. This follow-on award is the second year of a five-year program.

NASA's John F. Kennedy Space Center, Fla., has awarded a **joint venture contract** to **KAMAG Transporttechnik GmbH and Co.,** Ulm/Donau, West Germany and **Precision Fabricating and Cleaning Inc.,** Sharpes, Fla., to provide transporter units for Space Shuttle launch preparations. The contract has a basic value of $2,883,548 and is for the construction, testing and delivery of two self-propelled transporter systems in support of Space Shuttle operations at Kennedy and at Vandenberg Air Force Base, Calif. An option for a third such transporter may also be exercised. If the optional transporter is purchased, the total value of the contract will become $4,203,409. The fixed price contract began June 30, 1982 and will be completed Jan. 30, 1984.

ILC Industries, Inc., Space Systems Division, Houston, has signed a cost-plus-fixed-fee contract with NASA's Johnson Space Center to provide Shuttle crew equipment and training devices for spacewalks and in-cabin activities and Orbiter onboard stowage provisions for the equipment. The 9-month $4,638,000 contract began Mar. 31, 1982 and expires Dec. 31, 1982.

Fulton Shipyard, Inc., Antioch, Calif., has been awarded a $1.8 million dollar fixed-price contract by NASA's Kennedy Space Center, Fla., to provide moving bridge cranes that will be used in a new building to be built at the Space Center for processing solid rocket booster segments. Under terms of the contract, Fulton Shipyard will design, fabricate, install and test two 200-ton traveling electric cranes in the Solid Rocket Booster Rotation/Processing Facility. The contract calls for the work to be done

within the June 1, 1982 to Aug. 1, 1983 timeframe. The cranes will be used for lifting and rotating the heavy solid rocket motor segments arriving at Kennedy for pre-flight inspection, assembly and checkout.

Did You Know?

The **Space Shuttle** is a **featured attraction** at the NASA exhibit during the **1982 World's Fair** in Knoxville, Tenn., May 1 to Oct. 31. July was "Shuttle Month" at the fair and to help commemorate this event, Fair goers were treated to a very special hello from Space Shuttle astronauts T. K. Mattingly and Henry Hartsfield as they encircled the Earth during the fourth Shuttle flight. On July 1, the astronauts radioed a greeting to the World's Fair live from Columbia, encouraging everyone to see the NASA exhibit and speaking briefly of the achievements of the U.S. space program. NASA's 4,000-square-foot exhibit, on display in the Technology and Life Style Pavilion , focuses on "future uses and the role of the Space Shuttle." The exhibit includes two large Shuttle models, each between 15 and 20 feet long. One model depicts the Shuttle on the launch pad, while the smaller models illustrate the Shuttle in operational phases. An estimated 700,000 people visited the NASA exhibit during "Shuttle Month."

Listening to astronauts live from space was a new service recently offered by NASA and AT&T Long Lines. For a fee, anyone in the United States could dial 900/410-6272 and listen in on live commentary between fourth Space Shuttle astronauts T. K. Mattingly and Henry Hartsfield and NASA's Mission Control, Houston. Also broadcast on this line were Shuttle mission status reports and Flight Director briefings at Houston. Response to this "space" number was tremendous: 1,026,000 calls, averaging three minutes apiece, were placed during the 7-day mission. This telephone service was first offered during the second Space Shuttle mission last November, restricted to U.S. media. In March, for the third mission, the service was expanded to include overseas media. In response to heavy public request, NASA and AT&T opened the number in June to accommodate public calls. NASA hopes to offer this same service for the fifth flight in November.

NASA was awarded four Blue Pencil Publications Awards by the National Association of Government Communicators for outstanding government publications produced in 1981. **"A Free People Capable of Great Deeds"—the Story of STS-1,** received **second place** in the category "folders, brochures, leaflets, 16 pages or fewer." The mission report was written by Victor Seigel of the publications section at Headquarters. An **honorable mention** in the category "other serials for general or technical audience" was awarded to **Spinoff 1981,** designed by Beveridge & Associates, Inc., for Robert Schulman, graphics coordinator, Headquarters. Schulman also was art director for **"Going to Work in Space,"** a set of three commemorative Space Shuttle posters designed by Danne and Blackburn, Inc., which received **first place** in the "visual design, graphics" category. **Images of Saturn from Voyager 2,** a NASA FACTS leaflet designed by Ice House Graphics for the publications section at Headquarters placed **second** in the same category.

Two new NASA special publications have been issued: **Voyages to Saturn** by David Morrison and **Capturing Energy from the Wind** by James Schefter. Voyages to Saturn (NASA SP-451) presents chronologies and mission science summaries for each of the Voyager encounters with Saturn: Voyager 1 in November 1980 and Voyager 2 in August 1981. This book includes an index and almost 200 images, one-third of which are in color. For sale by the Superintendent of Documents, U.S. Government Printing Office, this volume is priced at $9.50. Capturing Energy from the Wind (NASA SP-455) is a semi-technical study of wind turbines as an energy source for the United States. Beginning with a brief history of this technology, the author explains the developmental work done by NASA, universities and private companies under NASA technical guidance to reach the goal of this research: create a wind turbine industry capable of producing electricity competitive with conventional and nuclear energy sources. Also for sale by the Superintendent of Documents, this volume is priced at $6.00.

George F. Page has been appointed **Deputy Director of NASA's Kennedy Space Center,** Fla. Director of Shuttle Operations at Kennedy since 1979, Page was launch director for the first three launches of the Space Shuttle. Page was named Director of Unmanned Launch Operations in 1975, and directed more than 54 major launches from Kennedy and the Western Test Range at Vandenberg Air Force Base, Calif., during the next four years.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Lansing M. Carson and F. Elvin Krasin .. Motorola, Inc., Scottsdale, Ariz.	Discriminator aided phase lock acquisition ..... for suppressed carrier signals	4,336,616	NRO/JPL
Richard S. Beitler, Frederic J. Sellers ... and George W. Bennett, General Electric, Cincinnati, Ohio	Control means for a gas turbine engine	4,338,061	LeRC
Robert L. Dotts and Jack W. Holt ..... Rockwell International, Downey, Calif.	Improved attachment system for silica tiles	4,338,368	JSC
Frederic S. Dawn and James V. Correale . NASA/JSC	Absorbent product and articles made therefrom	4,338,371	JSC
Madan M. Sharma ..... TRW, Inc., Redondo Beach, Calif.	Optical crystal temperature gauge with ..... fiber optic connections	4,338,516	JSC
Lien C. Yang ..... Caltech/JPL, Pasadena, Calif.	Method and device for destructive detection ..... of a substance	4,338,568	NRO/JPL
Harold G. Bush and ..... Richard E. Wallsom, Vought Corp., Hampton, Va.	Mechanical end joint system for structural ..... column elements	4,340,318	LaRC
Charles A. Barrett, Carl E. Lowell ..... and Abdus S. Khan, National Research Council, Washington, D.C.	NiCrAl ternary alloy having improved ..... cyclic oxidation resistance	4,340,425	LeRC

Space Shuttle Launches for 1982

Orbiter	Launch Date	Launch Site	Payload
*Columbia (OC-102)	March 22	KSC	OSS-1
*Columbia (OC-102)	June 27	KSC	DOD 82-1
Columbia (OV-102)	November 11	KSC	SBS-B, Telesat-E

* Successful launch

Expendable Launches for 1982

Name	Launch Date	Vehicle	Range	Mission Remarks
*RCA-C	January 15	Delta	ESMC	RCA communications. Reimbursable.
*Westar-IV	February 25	Delta	ESMC	Western Union communications. Reimbursable.
*Intelsat V-D	March 4	Atlas Centaur .	ESMC	Intelsat communications. Reimbursable.
*Insat 1-A	April 10	Delta	ESMC	India communications. Reimbursable.
*Westar-V	June 8	Delta	ESMC	Western Union communications. Reimbursable.
*Landsat-D	July 16	Delta	WSMC	NASA earth resources applications.
Telesat-G (Anik-D1) .	August 26	Delta	ESMC	Canada communications. Reimbursable.
Intelsat V-E	September 23 ...	Atlas Centaur .	ESMC	Intelsat communications. Reimbursable.
RCA-E	November 18 ...	Delta	ESMC	RCA communications. Reimbursable.
Intelsat V-F	December	Atlas Centaur .	ESMC	Intelsat communications. Reimbursable.

* Successful launch

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Unsinkable Raft

The design for a unique round life raft, credited with saving 230 lives in the last five years, was based in part on NASA technology developed during the Apollo program. Ocean-landed astronauts left the Apollo command module and waited in inflatable rafts for pickup by helicopter. These rafts, however, tended to overturn under the force of the helicopter's downwash. Subsequently, NASA's Johnson Space Center developed a new method of raft stabilization to counteract this, for which NASA received a patent.

Working independently, inventor Jim Givens of Tiverton, Rhode Island, developed a very similar system. He patented his own invention and then obtained an exclusive patent license for use of the NASA technology.

The 75-lb. Givens Buoy Life Raft* consists of a canopied topside and an underwater hemispheric ballast chamber. Its heavy ballast stabilization system negates capsizing. A flapper valve admits large amounts of water to the hemispheric chamber to provide ballast to keep the center of gravity consistent. The stabilization system compensates for changes in wave angle and for weight shifting as raft occupants move about.

This raft cannot overturn in normal seas. In the photo above, Coast Guard personnel try repeatedly to capsize the raft but fail. As proven repeatedly in survival operations, the raft automatically rights itself if overturned by waves of exceptional strength.

The Givens Buoy Life Raft has capacities ranging from 6 to 20 persons; a simple pull line triggers the automatic inflation process which takes 12 seconds to complete. It is manufactured by RPR Industries, Inc., Apex, N.C.

*NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

NASA
National Aeronautics and Space Administration

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